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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/002,272
Filing Date: November 15, 2001
Appellant(s): HOKE ET AL.

Scott S. Servilla
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed February 22, 2007 appealing from the Office action mailed August 24, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The changes are as follows:

WITHDRAWN REJECTIONS

The following ground of rejection is not presented for review on appeal because it has been withdrawn by the examiner:

Whether claims 48-53 and 55-58 are unpatentable under 35 U.S.C. § 112, second paragraph, as being indefinite.

GROUNDS OF REJECTION NOT ON REVIEW

The following grounds of rejection have not been withdrawn by the examiner, but they are not under review on appeal because they have not been presented for review in the appellant's brief:

The rejection of claims 48, 51-53 and 56-58 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 9-19 of U.S. Patent No. 6,190,627 in view of Adachi et al. (JP 52-12290).

The rejection of claims 49, 50 and 55 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 9-19 of U.S. Patent No. 6,190,627 in view of Adachi et al. (JP 52-12290), as applied to claim 48 above, and further in view of Okamoto et al. (JP 55-023039).

(7) Claims Appendix

A substantially correct copy of appealed claims 48-53 and 55 appears on page 16 of the Appendix to the appellant's brief. The minor errors are as follows:

In claim 50, "the hydrophobic protective material" should read as "a hydrophobic protective material," as presented in the Amendment After Final submitted on January 12, 2007, and entered on February 1, 2007.

(8) Evidence Relied Upon

WO 98/02235	DETTLING	01-1998
JP 52-122290	ADACHI et al.	10-1977
JP 55-023039	OKAMOTO et al.	02-1980

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

1. Claims 48, 51-53 and 56-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dettling (WO 98/02235) in view of Adachi et al. (JP 52-122290).

Regarding claims 48 and 53, Dettling discloses a device comprising:

an outer surface of a motor vehicle component that is exposed to a flow of ambient air (see page 7, lines 8-16), wherein said outer surface is coated with a catalyst composition (see page 7, line 17 to page 8, line 2). In addition, Dettling (page 15, lines 24-33) discloses that the catalyst composition may be protected with, "a porous protective coating", wherein the protective coating comprises,

"... a protective substance which is stable at temperatures up to 100 °C and is resistant to

> chemicals, salts, dirt and other contaminants which may adversely affect the catalyst composition."

Dettling, however, is silent as to the protective coating comprising, specifically, a porous overcoat of carbon.

Adachi et al. teaches the protection of a catalyst composition with a porous overcoat of carbon (i.e., a porous material, including activated carbon; see Abstract; also, Appellant's translation: page 20, lines 32-35 of the appeal brief; or PTO's translation: page 3, lines 11-15). Active carbon is known to be inherently stable at temperatures up to 100 °C. In addition, Adachi et al. teaches that by providing a porous overcoat of carbon,

> "... the catalyst component is not poisoned by the compounds of sulfur, lead, calcium, nickel and the steam, vanadium compound, nickel compounds, etc. in the waste gas... so the catalyst activity is maintained stably for a long time." (Appellant's translation: page 20, lines 20-23 of the appeal brief; see also PTO's translation: page 2, line 21 to page 3, line 2).

> "... the compounds of sulfur, phosphorous, lead, etc. are adsorbed selectively to the porous material to prevent the adsorption or sticking to the catalyst component and prevent the degradation of the catalyst activity. Further, the severe degradation of the strength of the catalyst is prevented." (Appellant's translation: page 20, lines 28-31 of the appeal brief; see also PTO's translation: page 3, lines 3-10).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute a porous overcoat of carbon for the porous protective coating in the apparatus of Dettling, because the porous overcoat of carbon is capable of protecting the catalyst composition from poisoning and degradation from a variety of contaminants, as taught by Adachi et al., and the substitution of one known protective coating for another known protective coating, on the

basis of suitability for the intended use, merely involves routine skill in the art.

Regarding claim 51, Dettling discloses that the catalyst composition is selected from the group comprising base metals, precious metals as well as salts and oxides thereof, and combination thereof (see page 8, lines 3-19; claim 11).

Regarding claim 52, Dettling further discloses that the catalyst composition may comprise base metals, including manganese, wherein the base metals are typically used in the form of oxides." (see page 8, lines 3-10). Although Dettling does not state that the oxide of manganese is to comprise, specifically, manganese dioxide, it would have been obvious for one of ordinary skill in the art at the time the invention was made to select a catalyst composition comprising manganese dioxide in the apparatus of Dettling, on the basis of suitability for the intended use, because the Examiner takes official notice that manganese dioxide is a well known catalyst component used for waste gas purification.

Regarding claim 56, Dettling discloses that the outer surface is selected from the outer surface of radiators, air-conditioner condensers, charge air coolers, transmission coolers, and inserted devices (see page 7, lines 8-16; page 10, lines 1-12; page 11, lines 6-28).

Regarding claim 57, Dettling discloses that the catalyst composition is selected from manganese dioxide, platinum, palladium, and mixtures thereof (see page 8, lines 3-19; claim 11).

Regarding claim 58, Dettling discloses a support material selected from ceria, alumina, titania, silica, zirconia, and mixtures thereof (see page 8, lines 20-31).

2. Claims 49, 50 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dettling (WO 98/02235) in view of Adachi et al. (JP 52-122290), as applied to claim 48 above, and further in view of Okamoto et al. (JP 55-023039).

The collective teaching of Dettling and Adachi et al. is silent as to at least one layer of a hydrophobic protective material overcoating the overcoat of carbon, wherein the hydrophobic protective material is capable of substantially preventing liquid water and/or water vapor from reaching the catalyst composition or overcoat of carbon.

Okamoto et al. (Abstract) teaches that the gas adsorption power of activated carbon is enhanced by treating the carbon with a water repellent resin, such as PTFE (a fluoropolymer), PP or PS, or a water repellant made of a silicon-containing compounds, such as dimethylchloro-silane or silicone oil. (see also translation: page 3, line 21 to page 4, line 15).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide at least one layer of a hydrophobic protective material to overcoat the porous overcoat of carbon in the modified apparatus of Dettling, on the basis of suitability for the intended use, because the hydrophobic protective material prevents the condensation of moisture in the carbon pores so that the activated carbon exhibits a stable adsorption power, as taught by Okamoto et al.

(10) Response to Argument

1. The rejection of claims 48, 51-53 and 56-58 under 35 U.S.C. 103(a) as being unpatentable over Dettling (WO 98/02235) in view of Adachi et al. (JP 52-122290).

Claim 48

Appellant (beginning at page 8, line 14) argues,

> "... WO 98/02235 teaches the use of a resistant, repellent overcoat to protect the underlying catalyst from roadway contaminants such as chemicals, salts, dirt and other contaminants which may adversely affect the catalyst composition....
>
> JP 52-122290 teaches the use of an adsorptive overcoat material to protect an

> exhaust gas catalyst used to purify a waste gas stream from automobiles, combustion furnaces, oil burners, incinerators and chemical plants to protect the catalyst from waste gas stream contaminants such as S, P, Pb, Ca, and Ni...
>
> ... the skilled artisan reading WO 98/02235 together with JP 52-122290 would not be motivated to substitute the adsorptive coatings disclosed in JP 52-122290 for the resistive or repellent coating disclosed in WO 98/02235 to repel chemicals, salts, dirt and other contaminants.

The Examiner respectfully disagrees.

Dettling discloses that a porous protective coating, e.g., of plastic material, may be used to protect a catalytic surface (see page 15, lines 24-33). Dettling, however, is silent as to whether the material forming the coating may comprise carbon.

Adachi et al. also teaches that a porous protective coating, e.g., of activated carbon, may be used to protect a catalytic surface (see PTO's translation: claim 2; page 3, lines 11-15). For instance, Adachi et al. teaches,

> "... at least one portion of the surface of the catalyst is covered with a porous layer whose components differ from those of the catalyst." (see PTO's translation: claim 1 at page 1; with emphasis added).
>
> "The substance that differs from the catalyst refers to a properly porous substance so as not to interrupt a reaction substance and a product to enter and exit from the catalyst surface since the main content of the invention is to protect the catalyst by covering the surface with a substance that does not always have a catalytic activity." (see PTO's translation: page 3, lines 16-19).

Adachi et al. further teaches that the porous protective layer, e.g. of activated carbon, protects the underlying catalyst from contaminants such as compounds of, "sulfur, phosphorous, lead, calcium, nickel and the like, steam, a vanadium compound and a nickel compound in an exhaust

gas," (see PTO's translation: last line on page 2 to page 3, line 2).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute the porous protective coating as taught by Adachi et al. for the porous protective coating as disclosed by Dettling, on the basis of suitability for the intended use and absent as showing of unexpected results thereof, because both of the coatings are porous, both of the coatings are recognized as providing catalyst protection against contaminants and aging, and it has been held that the substitution of known equivalent structures involves only ordinary skill in the art. *In re Fout* 213 USPQ 532 (CCPA 1982); *In re Susi* 169 USPQ 423 (CCPA 1971); *In re Siebentritt* 152 USPQ 618 (CCPA 1967); *In re Ruff* 118 USPQ 343 (CCPA 1958). When a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result.

Furthermore, Appellant (beginning at page 9, line 9) argues,

> "...There is no teaching or suggestion in WO 98/02235 to provide an adsorptive coating over the catalyst to prevent catalyst poisoning. To do so would render the device taught in the reference unsuitable for its intended purpose, which is to provide an article with a coating that repels contaminants such as chemicals, salts, dirt and other contaminants from the catalyst surface. If the proposed modification of a reference renders the reference unsuitable for its intended purpose, there can be no suggestion to make the proposed modification."

The Examiner respectfully disagrees. The intended purpose of Dettling is to provide a device that is capable of catalytically converting pollutants to harmless compounds, where the catalytically active components of the device are protected from contamination and premature

aging. The Examiner asserts that the substitution of the porous protective coating, e.g., of activated carbon, of Adachi et al. for the porous protective coating, e.g., of plastic material, in the apparatus of Dettling would not destroy the intended purpose, since the device would still be capable of catalytically converting pollutants to harmless compounds, and the catalytically active components of the device would still be protected from contamination and premature aging. The porous coating of activated carbon would protect the catalytically active layer because,

> "... Using a double structure in which at least one portion of the catalyst surface is covered with a porous substance which differs from the catalyst to be used, compounds such as sulfur, phosphorous and lead are selectively absorbed in the porous substance to prevent absorption or adhesion of the compounds in or on the catalyst compounds, thereby preventing the deterioration of catalytic activity and further preventing a severe deterioration of the catalyst strength due to a reaction occurring between the catalyst components and the sulfur compound and the like." (see PTO's translation of Adachi et al.: page 3, lines 3-10).

Appellant (beginning on page 9, line 18) then argues,

> "...The various coatings in JP 52-12290 are described as being useful for protecting the catalyst from S, Pb, Ca, and Ni in a waste gas stream. Appellants submit that it cannot be assumed that a material suitable for treating a waste gas stream would and for adsorbing S, Pb, Ca and Ni would be suitable as a protective overcoat for a catalyst used in the treatment of ambient air to repel chemicals, salts, dirt and other contaminants because the two types of catalysts encounter different temperatures, pollutant mix/concentration and other use conditions and the protective coatings have completely opposite functions. There is no teaching or suggestion in JP 52-12290 that a porous carbon coating would be suitable for protecting a catalyst the types of contaminants encountered in WO 98/02235, namely, chemicals, salts, dirt and other contaminants. It appears that the Office Action has relied on improper hindsight in assuming that the carbon coating used in a waste gas stream for protecting the catalyst

from different types of contaminants would be successful in protecting the catalyst in the instant invention. There is no teaching in JP 52-12290 that a carbon coating would be useful to coat a catalyst for treating the atmosphere, and thus there is no reasonable expectation of success that the coating in JP 52-12290 would protect the catalyst in WO 98/02235 from chemicals, salts, dirt and other contaminants."

The Examiner respectfully disagrees.

In response to Appellant's argument that Adachi et al. is nonanalogous art, it has been held that a prior art reference must either be in the field of Appellant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the Appellant was concerned, in order to be relied upon as a basis for rejection of the claimed invention. See *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). In this case, the Examiner asserts that the reference to Adachi et al. is reasonably pertinent to the particular problem with which Appellant, as well as Dettling, was concerned, because Adachi et al. is similarly concerned with providing a means for protecting a catalyst layer from contamination and degradation.

In response to Appellant's argument that the Examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the Appellant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

In addition, Appellant's argument that there would be no reasonable expectation of success that the porous protective coating of Adachi et al. would protect the Dettling catalyst

layer from chemicals, salts, dirt and other contaminants is not found persuasive. Adachi et al. has already shown that a porous protective coating of activated granular carbon is capable of protecting an underlying catalyst layer from various contaminants, such as compounds of sulfur, phosphorous, lead, calcium, nickel, etc. (see PTO's translation: page 2, line 21 to page 3, line 10). It is further noted that Adachi et al. teaches that for the porous protective coating, "[t]he covering thickness is sufficient if it is 5 μm to 1000 μm, and the covering ratio is also sufficient if it is 10% to 100% in relation to the surface area of the catalyst." (see PTO's translation: page 3, lines 19-21). Clearly, using common sense, a coating layer of up to 1000 μm, or 1 mm thick, would be structurally capable of providing the underlying catalyst layer with at least some degree of protection against a variety of larger scale contaminants, such as the salt, dirt, etc. described by Dettling, by serving as a physical barrier to such contaminants. As such, the Examiner maintains that the combined teachings of Dettling and Adachi et al. would have provided one of ordinary skill in the art at the time the invention was made with at least some degree of predictability and a reasonable expectation of success in making the proposed combination.

Claims 49, 51-52 and 56-58

Because no further argument has been present by Appellant (see page 10 of the Brief), the same comments with respect to Dettling and Adachi et al., regarding claim 48 above, apply.

In addition, with respect to claim 52, the statement that, "manganese dioxide is a well-known catalyst component used for waste gas purification," has been taken to be admitted prior art, because Appellant has failed to traverse the Examiner's assertion of official notice.

Claim 53

Appellant (beginning at the bottom of page 10) then argues,

> "...The Office Action fails to specifically address the limitations of claim 53. There is no teaching or suggestion in WO 98/02235 or JP 52-122290 of the particular types of carbons recited in claim 53. Because the Office Action fails to recite prior art containing all of the claimed elements of claim 53, *prima facie* obviousness has not been established. The rejection of claim 53, therefore, should be reversed."

The Examiner respectfully disagrees. As specifically set forth in the rejection, Adachi et al. teaches that the porous overcoat of carbon may comprise a porous material, such as activated carbon. (See Abstract, as well as the PTO's translation of the Adachi et al. reference, at page 3, lines 11-15). Furthermore, one of ordinary skill in the art would recognize that the activated carbon as taught by Adachi et al. would comprise an activated granular carbon, given that the porous protective coatings as described in the working examples of Adachi et al. are applied as a granular coating (i.e., using a "granulator"; see Working Examples 1 and 2, beginning on page 5 of the PTO's translation).

2. The rejection of claims 49, 50 and 55 under 35 U.S.C. 103(a) as being unpatentable over Dettling (WO 98/02235) in view of Adachi et al. (JP 52-122290), as applied to claim 48 above, and further in view of Okamoto et al. (JP 55-023039).

Claims 49 and 50

Appellant (beginning on page 11, line 17) argues,

> "... it is incumbent upon the Examiner to supply a full translation of JP 55-023039 in the Examiner's Answer as required by MPEP § 1207.02. The extent of the teachings of the Abstract of JP 55-023039 is unclear, and it is quite possible that a translation of the full text document may include teachings away from the invention that will preclude an obviousness rejection."

Please note that a full translation of the Okamoto et al. reference has been provided herein. Based on the translation, the Examiner maintains that the various features taught in the Okamoto et al. abstract are fully supported in the translated disclosure (see, for example, translation page 3, line 21 to page 4, line 6; also, page 4, lines 10-15).

Appellant (beginning on page 12, line 11) then argues,

> "... There is no teaching or suggestion in any of the references relied upon by the Office Action to apply at least one overcoat of a hydrophobic protective material over the overcoat of carbon. The Office Action admits that WO 98/02235 and JP 52-12290 fail to teach the limitations of claims 49 and 50. As such, *prima facie* obviousness has not been established."

Appellant's argument is not persuasive because the rejection of claims 49 and 50 has been based on a combination of three references— Dettling, Adachi et al. AND Okamoto et al. As indicated in the rejection above, the feature of the at least one overcoat of a hydrophobic protective material over the overcoat of carbon is taught by Okamoto et al. Appellant, however, has not addressed any of the teachings of Okamoto et al.

Appellant (beginning on page 12, line 19) then argues,

> "... The Office Action now suggests that a person of skill in the art would further modify the modified structure in WO 98/02235 to provide a hydrophobic coating over the absorptive coating. Appellants maintain that this further modification would still destroy the intended function of the original coating in WO 98/02235, which is to repel chemicals, salts, dirt and other contaminants by providing an adsorptive coating of carbon having a hydrophobic coating. Hence, there would be no motivation to combine the references."

The Examiner respectfully disagrees.

The intended function of Dettling is to provide a device that is capable of catalytically converting pollutants to harmless compounds, where the catalytically active components of the device are protected from contamination and premature aging. As commented above, the substitution of the porous protective coating, e.g., of activated carbon, of Adachi et al. for the porous protective coating, e.g., of plastic material, in the apparatus of Dettling would not destroy the intended purpose of the device, since the device would still be capable of catalytically converting pollutants in the atmosphere into harmless compounds, and the catalytically active components of the device would still be protected from contamination and premature aging, in the manner as described by Adachi et al. (see PTO's translation: page 3, lines 3-10).

In addition, the Examiner asserts that the provision of a hydrophobic coating, e.g., a fluoropolymer, as taught by Okamoto et al., over the layer of activated carbon in the modified device of Dettling would not destroy the intended purpose of the device, since the device would still be capable of catalytically converting pollutants in the atmosphere to harmless compounds, and the catalytically active components of the device would still be protected from contamination and premature aging. In addition to the protection provided by the activated carbon layer, the hydrophobic coating of fluoropolymer, etc., would further protect the underlying catalyst layer in the device, by preventing the condensation of moisture on the activated carbon layer (i.e., in the manner as described by Okamoto et al.; see translation: page 3, line 21 to page 4, line 6), and by inherently resisting the various chemicals, salts, dirt and contaminants encountered by the Dettling device (i.e., in the manner described by Dettling, on page 15, lines 24-33). If anything, the substitution of the porous coating of activated carbon, as taught by Adachi et al., for porous protective coating in the Dettling device, and the additional

provision of the hydrophobic coating layer, as taught by Okamoto et al., over the porous coating of activated carbon in the modified Dettling device, would serve to further enhance the intended function of catalytically converting pollutants in the atmosphere to harmless compounds, since the device would now comprise two layers of catalyst protection against contaminants and premature aging, instead of the single layer of catalyst protection used by Dettling.

When a patent simply arranges old elements with each element performing the same function that it has been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious. Although the combination of old elements performs a useful function, the combination adds nothing to the nature and quality of the subject matter already patented.

Appellant (beginning at page 13, line 5, of the Brief) then argues,

> "... Moreover, reliance on the Abstract JP 55-023039 is misplaced. First, there is no teaching or suggestion in the Abstract of JP 55-023039 that the adsorptive power of the activated carbon is "enhanced" as stated by the Office Action. Second, the rejection fails to address why one of ordinary skill in the art would remove the repellant layer as taught in WO 98/02235, which is designed to repel chemicals, salts, dirt and other contaminants, replace it with an adsorptive layer and then place a hydrophobic layer over the layer of carbon. There is no teaching that a hydrophobic layer would be useful in repelling chemicals, salts, dirt and other contaminants, as required in WO 98/02235, and thus, there would be no reasonable expectation of success in making the proposed combination suggested in the Office Action. Because a reasonable expectation of success is lacking, the Office Action further fails to establish a prima facie case of obviousness."

The Examiner respectfully disagrees. Firstly, the Okamoto et al. abstract specifically states that the purpose of the invention is "[t]o enhance the gas adsorption power of activated carbon by treating the carbon with a water repellent." (see "purpose" in the Abstract).

Secondly, Appellant asserts that, "[t]here is no teaching that a hydrophobic layer would be useful in repelling chemicals, salts, dirt and other contaminants, as required in WO 98/02235." However, please note that Dettling specifically discloses this function for the materials forming the hydrophobic layer (see page 15, lines 24-33; also, page 5, lines 26-29).

Thirdly, one having ordinary skill in the art at the time the invention was made would have been motivated to substitute the porous protective coating, i.e., of activated granular carbon, as taught by Adachi et al. for the porous protective coating in the Dettling device, and to further add a hydrophobic layer, as taught by Okamoto et al., over the porous protective coating the modified Dettling device, on the basis of suitability for the intended use thereof, because the provision of two catalyst protecting layers, opposed to a single catalyst protecting layer, would allow for the catalyst layer to be protected from an even wider range of contaminants, including the various types of contaminants discussed in Adachi et al., as well as moisture and the various types of contaminants discussed in Okamoto et al. and Dettling.

Lastly, Appellant's argument that there would be no reasonable expectation of success in making the proposed combination of device comprising a catalyst layer, overcoated with a porous carbon layer, which is then overcoated with a hydrophobic layer, is not found persuasive. The prior art has already shown that a porous protective coating of activated granular carbon is capable of protecting an underlying catalyst layer from various contaminants and premature aging (see Adachi et al.). The prior art has further shown that a hydrophobic layer, e.g., of a fluoropolymer, is capable of protecting an underlying catalyst layer from various contaminants and premature aging (see Dettling). Furthermore, the prior art has shown that a hydrophobic layer, e.g., of a fluoropolymer, is also capable of protecting an underlying layer of activated

carbon from moisture and other contaminants (see Okamoto et al.). Thus, the combined teachings of Dettling, Adachi et al. and Okamoto et al. would have provided one of ordinary skill in the art at the time the invention was made with at least some degree of predictability and a reasonable expectation of success in making the proposed combination, given that activated granular carbon has been recognized in the art as a catalyst protecting layer, and hydrophobic coatings, such as fluoropolymers, have been recognized in the art as both a catalyst protecting layer and an activated carbon protecting layer.

Appellant (beginning on page 13, line 21) then argues,

> "... Because the catalyst in WO 98/02235 is expected to be exposed to high temperatures, the need for a water repellent coating to "prevent the condensation of moisture in the carbon pores so that the activated carbon exhibits stable absorption power" is probably unnecessary due to the fact that moisture would probably not be problematic at high temperatures..."

The Examiner respectfully disagrees. Appellant states that the catalyst coating in the Dettling device is "expected to be exposed to high temperatures." However, this is not true. In fact, Dettling specifically states that, "[t]he present invention relates to a method for the low temperature cleaning of the atmosphere." (see page 1, lines 5-6; emphasis added). For example, the gas to be purified by the catalytic coating may comprise ambient air (see page 5, lines 13-17). Thus, one of ordinary skill in the art at the time the invention was made would have been motivated to provide the hydrophobic layer of Okamoto et al. over the porous protective coating layer in the modified apparatus of Dettling, given that, at lower temperatures, there is a tendency for water to condense in the pores of the activated carbon, as taught by Okamoto et al. (see translation: page 3, lines 4-11; page 3, line 21 to page 4, line 6).

Claim 55

Because no further argument has been presented by Appellant (see page 14 of the Brief), the same comments with respect to Dettling, Adachi et al. and Okamoto et al., regarding claims 48 and 49 above, apply.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Jennifer A. Leung Jennifer A. Leung

Conferees:

Glenn Caldarola

Jennifer Michener

JENNIFER MICHENER
QUALITY ASSURANCE SPECIALIST

Adachi et al.
PTO's translation

PTO: 2005-0891

Japanese Published Unexamined (Kokai) Patent Publication No. S52-122290; Publication Date: October 14, 1977; Application No. S51-39069; Application Date: April 7, 1976; Int. Cl.[2]: B01J 35/10 B01J 21/04 B01J 21/18 B01J 23/02 B01J 23/06 B01J 23/34 B01J 23/70 // B01D 53/34 C01B 21/02; Inventor: Shichiro Adachi et al.; Applicant: TDK Electronics Co., Ltd.; Japanese Title: Haigasu Shori-you Shokubai (Catalyst for Treating Exhaust Gas)

Specification

1. Title of Invention

Catalyst for Treating Exhaust Gas

2. Claim(s)

1. A catalyst for treating an exhaust gas, characterized in that at least one portion of the surface of the catalyst is covered with a porous layer whose components differ from those of the catalyst.

2. The catalyst for treating the exhaust gas, as disclosed in Claim 1, characterized in that a substance that covers the portion of the surface of the catalyst is made of at least one type selected from the following types of transition metal oxide or sulfate: aluminum oxide; activated carbon; alkali metal oxide; alkali earth metal oxide; iron; manganese; copper; nickel; cobalt; zinc; cadmium.

3. Detailed Description of the Invention

This invention pertains to a catalyst for treating an exhaust gas that contains nitrogen oxide. More specifically, this invention relates to a catalyst suited for treating an

exhaust gas, which is capable of effectively reducing and eliminating nitrogen oxide (henceforth referred to as NOx) in the gas containing NOx and sulfur oxide together.

An air pollution by NOx contained in exhaust gases from automobiles, various combustion furnaces, heavy oil burners, incinerators, chemical plants and the like has been focused as a social problem. An effective detoxification measure for the problem is required.

The following means for eliminating NOx in exhaust gases are known as conventional means: a means to make NOx to be absorbed in a cleaning solution while it passes through the solution; a means to absorb NOx using an absorbent; a means to convert NOx into a non-toxic substance by being brought into contact with a catalyst.

Nevertheless, since the cleaning means uses a large amount of the solution, the handling is inconvenient, and large-scale equipment is also required. Thereby, the cleaning means is not suited for treating a large amount of exhaust gas. The absorbing means is not proper for treating a large amount of exhaust gas. Accordingly, the means using the catalyst is to be suited for the use. As for catalysts for the treatment of the exhaust gases, metal oxides such as platinum metals, iron, manganese, copper, molybdenum and vanadium or a variety of catalysts in which these metal oxides are carried with carriers such as alumina, silica and the like are proposed. However, these widely known catalysts are weak mainly to toxification by sulfur oxide that is contained in the exhaust gases, which results in a problem on the longevity.

The present invention is produced to eliminate the disadvantage and to offer a catalyst at a lower cost, whose activity is stably maintained for a long period of time without having toxification of the catalyst components by compounds such as sulfur,

phosphorus, lead, calcium, nickel and the like, steam, a vanadium compound and a nickel compound in an exhaust gas containing NOx.

More specifically, the invention is a catalyst that is used for detoxifying NOx in an exhaust gas. Using a double structure in which at least one portion of the catalyst surface is covered with a porous substance which differs from the catalyst to be used, compounds such as sulfur, phosphorus and lead are selectively absorbed in the porous substance to prevent absorption or adhesion of the compounds in or on the catalyst components, thereby preventing the deterioration of the catalytic activity and further preventing a severe deterioration of the catalyst strength due to a reaction occurring between the catalyst components and the sulfur compound and the like.

The following porous substances are used for the invention: alkali metal oxides; alkali earth oxides; transition metal oxides; a mixture thereof; a compound thereof; a compound of sulfate thereof. The alkali metal oxides include aluminum oxide, activated carbon, Na_2O_2 and K_2O; the alkali earth oxides CaO and SrO; the transition metal oxide Fe, Mn, Cu, Ni, Co, Zn and Cd.

The substance that differs from the catalyst refers to a properly porous substance so as not to interrupt a reaction substance and a product to enter and exit from the catalyst surface since the main content of the invention is to protect the catalyst by covering the surface with a substance that does not always have a catalytic activity. The covering thickness is sufficient if it is 5 μm to 1000 μm, and the covering ratio is also sufficient if it is 10% to 100% in relation to the surface area of the catalyst. Furthermore, The catalyst components used for the invention are not limited to specific components alone as long as they are effective as catalysts for treating exhaust gases, such as platinum carrier catalysts

as known as exhaust gas treating catalysts, sintered bodies of transition metal oxides including vanadium, iron, copper, nickel, cobalt, manganese, chromium, molybdenum and tungsten, these catalysts carried with carriers and sulfate of these catalysts that is carried with carriers. No limitation in the use of catalysts is also natural as in the main content of the invention.

There are the following exhaust gases to be treated by the invention: a boiler gas containing NOx; exhaust gases from various combustion furnaces, an incinerator, a heavy oil burner, a chemical plant and an automobile.

As for reducible gases to be added as needed at a contact reduction of NOx, carbon monoxide, hydrogen sulfide, hydrogen, hydrogen carbonate, a mixture thereof and a water gas are used.

Ammonia is used as a reducible gas as in the working examples as below. As is clear in the main content of the invention, the reducible gas is not limited to ammonia alone. Catalysts to be used are also not limited to those used in the working examples alone.

For example, when ammonia as a reducible gas is added to a NOx containing exhaust gas using a catalyst of the invention and treated at 200 to 600°C at $1x\ 10^{R}$ to $1 x\ 10^{5}\ hr^{-1}$ space velocity, the exhaust gas is detoxified at a high purifying efficiency for a long period of time. The amount of ammonia needs to be added at an at least 2/3 molar ratio in relation to NOx. If a complete cleaning is not required, the amount of ammonia can be reduced.

The invention is described hereinbelow in detail using the working examples.

Working Example 1

Iron oxide and vanadium oxide are carried with a carrier made of porous aluminum with an 8 mm spherical diameter at a Fe/V = 7/3 (atomic ratio) using a regular impregnation means. It is identified that the carrier components are contained at 5.0 w% in relation to alumina (this catalyst is defined as A).

Fe_2O_3 is applied onto the surface of catalyst A using a regular bread-shaped granulator, and catalyst A is baked at 500°C to be covered with Fe_2O_3 (this catalyst is defined as B). A double structure in which the surface is covered with a Fe_2O_3 layer at about 50 μm is identified at an observation with a microscope.

A catalyst tank filled with catalysts A and B obtained as above is kept at 300°C. An exhaust gas (composed of NO at 100 ppm, SO_2 at 150 ppm, CO_2 at 10%, steam at 10%, O_2 at 4% and N_2 for the remaining portion) from a boiler that uses heavy oil B is then passes through the catalyst tank at a 5000 hr^{-1} space velocity in relation to the amount of the catalysts for 1000 hours (these catalysts are defined as A' and B').

As for the catalysts A, A', B and B' and a catalyst B'' in which the Fe_2O_3 layer is removed from the surface of the catalyst B', these catalysts each at 40 cc are filled in quartz glass reaction tubes. A mixture gas being composed of NO at 150 ppm, SO_2 at 150 ppm, NH_3 at 150 ppm, O_2 at 1.5%, steam at 10% and nitrogen for the remaining portion then passes through the reaction tubes at a 5 x 10^5 hr^{-1} space velocity to measure a NO purification ratio at NO (entry) – NO (exit)/ No (entry) x 100. Additionally, elements on the surfaces of the catalysts are analyzed by a fluorescent X ray analysis. Sulfur and a small amount of phosphorus are detected other than the catalyst components from the

samples after 1000 hours of a test. The measuring result and the purification ratio of sulfur are indicated in Table 1.

Table 1

	Purification ratio at 300°C	S (Kα primary)
A A' B B' B''	[Please refer to the original description]	

Working Example 2

Using a similar production method as in Working Example 1, a catalyst C in which the surface of the catalyst A of Working Example 1 is covered with a Mn_2O_3 layer at about 70 μm is obtained. The testing results for the catalyst C tested at similar conditions as those for Working Example 1 are shown in Table 2. As is similar as in Working Example 1, a catalyst C' is obtained after exposing it in a boiler gas for 1000 hours whereas a catalyst C'' is obtained after removing the Mn_2O_3 layer on the surface of the catalyst C'.

Table 2

	Purification ratio at 300°C	S (Kα primary)
A A' C C' C''	[Please refer to the original description]	

As is clear in the above results, the active components of the catalysts A and A' is toxified with sulfur oxide and the like in the exhaust gas to deteriorate the activity. In contract, components such as sulfur oxide (assumed to be mainly SO_2) of the catalysts B, B', B'', C, C' and C'' are absorbed in Fe_2O_3 and Mn_2O_3 that are apparently applied on the surfaces and do not reach the catalyst components to reduce the deterioration of the

catalytic activity. As similarly to as in Working Example 1, a catalyst of the invention having a double structure in which the surface is covered with various porous substances different from the catalyst components is tested using other catalyst components. Sufficient testing results are obtained as similarly to those of the above catalysts.

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WATER REPELLENT ACTIVE CARBON
[Hassuisei Kasseitan]

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SPECIFICATION /191*

1. Title

Water Repellent Active Carbon

2. Claims

Water repellent active carbon that is subjected to a water repellent treatment with a water repellent agent in such a manner as not to diminish the active property of said active carbon.

3. Detailed Description of the Invention

The present invention pertains to water repellent active carbon that is suitable for treating harmful gases and malodorous gases that contain moisture.

In recent years, as measures to eliminate air pollution caused by sulfur oxides, nitrogen oxides, and the like, and bad odors generated from human-waste treatment plants, sewage treatment plants, fish or animal offal processing plants, and so forth as well as indoor air contamination caused by cigarettes or body odors, bad smells inside refrigerators, and so forth, adsorption methods, absorption methods, combustion methods, oxidation methods, masking methods, and so forth have been employed, of which adsorption by means of active carbon is the most commonly employed method because it can eliminate harmful gases and malodorous gases simply and efficiently.

Incidentally, active carbon is produced from coconut husks, coal, petroleum pitch, and the like as the raw material, and it has numerous

* Number in the margin indicates pagination in the foreign text.

fine pores, thus having a large specific surface area, and is capable of eliminating harmful gases and malodorous gases by means of these numerous fine pores and the large surface area.

However, in the case of treating a malodorous gas or the like with the aforesaid active carbon, the active carbon has a drawback in that, when the temperature of the active carbon is lower than that of the malodorous gas and also when said gas contains moisture, the moisture in the gas condenses inside the fine pores of the active carbon, thereby forming what is called dew condensation; as a result, the adsorption performance of the active carbon deteriorates dramatically.

Currently practiced methods to prevent the aforesaid dew condensation are (1) to eliminate moisture in the gas and (2) to set the temperature of the active carbon higher than that of the gas. These methods (1) and (2), however, require the installation of a drying device and heating device in addition to an adsorption device, which leads to an increase in equipment cost and to a need for enormous thermal energy. Moreover, they have the shortcoming of diminishing the simplicity of the adsorption operation, which is the advantage of the use of active carbon.

Accordingly, the present inventors conducted extensive research to solve the aforesaid problems and, as a result, learned that treating active carbon with a water repellent agent, such as polytetrafluoroethylene, polypropylene, or the like, makes it possible

to prevent moisture from entering the fine pores of active carbon and /192 from forming dew condensation even when the gas is treated under the conditions in which the temperature of the active carbon is lower than that of the gas and also in which the gas contains moisture, thereby achieving water repellent active carbon that has stable and excellent adsorption performance.

That is, the present invention is achieved by treating active carbon with a water repellent agent in such a manner as not to diminish the active property of said active carbon.

Examples of the water repellent agent used in the present invention include fluororesins, such as polytetrafluoroethylene and the like; polyethylene; polypropylene; polystyrene; liquid paraffin; silicon-containing compounds, such as silicone oil, dimethyl dichlorosilane (DMCS), hexamethyl disilazane (HMDS), and the like; and so forth.

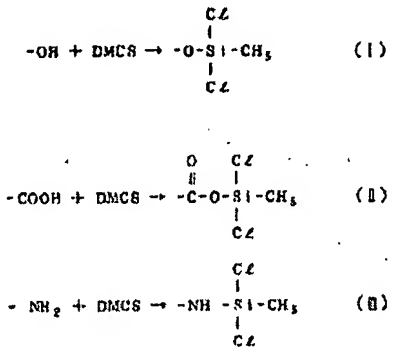
As the method to treat active carbon with a water repellent agent in the present invention, the following methods, for example, may be employed.

(1) A method that dissolves a water repellent agent in a solvent, immerses active carbon in this solution and stirs thoroughly, subsequently takes out the active carbon from the solution, and eliminates the solvent by heating or under reduced pressure, thereby coating the active carbon with the water repellent agent. In this case, for the purpose of not diminishing the active property of the active

carbon, the coating must be done so as not to have the water repellent agent embedded in the fine pores of the active carbon.

(2) A method that mixes active carbon in a powder form or granular form with a water repellent agent and subsequently forms the mixture under a heated or pressurized condition, thereby imparting water repellency to the active carbon. In this case, the proportion of the water repellent agent contained in the active carbon is preferably from 0.1 to 50 % or thereabouts.

Especially when, in the aforesaid methods (1) and (2), a silicon-containing compound, such as dimethyl dichlorosilane (DMCS) or the like, is used as the water repellent agent, the hydroxyl groups (-OH), carboxyl groups (-COOH), or amino groups ($-NH_2$) that are present in active carbon and said silicon-containing compound (for example, DMCS) undergo the following reactions:



and the water repellent agent is firmly immobilized onto the active carbon; as a result, the water repellent agent can exhibit the water repellent effect stably for a long period.

The following will explain working examples of the present invention.

Working Example 1

First, 0.5 g polystyrene was dissolved in 50 mL toluene, and, into this solution, 50 g of 4- to 6-mesh active carbon formed from coconut husks was then immersed and stirred thoroughly. Next, the coconut husk active carbon was taken out from the polystyrene solution and heated to evaporate toluene, after which it was further heated at 150 °C for 3 hours, thereby obtaining water repellent active carbon.

Working Example 2

Ten grams of a polytetrafluoroethylene powder whose grain size was from 100 to 200 mesh and 50 g of coconut-husk active carbon whose grain size was from 100 to 200 were kneaded together thoroughly and subsequently heated for 1 hour at 200 °C in a nitrogen gas flow. Thereafter, the mixture was pressure-formed, thereby obtaining water repellent active carbon whose grain size was from 4 to 6 mesh.

Working Example 3

After 1 g dimethyl dichlorosilane was dissolved in acetonitrile, 50 g of a coconut husk formed product whose grain size was 4 to 6 mesh was immersed in this solution and heated at 50 °C for 5 hours. Thereafter, the coconut husk active carbon was taken out from the dimethyl dichlorosilane solution, and acetonitrile was evaporated. The active carbon was further heated at 150 °C for 3 hours, thereby obtaining water repellent active carbon.

Then, 10 g each of the water repellent active carbons obtained in Working Examples 1 through 3 and 10 g of an untreated coconut husk active carbon having a mesh size of from 4 to 6 (Comparative Example) were packed individually in glass reaction tubes, after which air whose humidity was 95 % was run through these filled active carbon layers for 5 hours at a rate of 2 L/minute, and the weight increase of each type of active carbon after the air flow was investigated. The results are shown in the table below.

TABLE /193

	Initial Weight	Weight After The Passage Of Moisture-Containing Air	Weight Increase
Comparative Example	10 g	14.5 g	4.5 g
Working Example 1	"	10.5 g	0.5 g
Working Example 2	"	10.8 g	0.8 g
Working Example 3	"	10.4 g	0.4 g

As is evident from the table above, the water repellent active carbons of the present invention exhibited extremely low water absorbency when the moisture-containing air was run through them, and it can be seen that their water absorbency was decreased to from 1/6 to 1/10 that of the untreated active carbon.

Further, when the retention rate of sulfur dioxide adsorbed by the present working examples 1 through 3 was measured, it was found to be from 9.2 to 9.8 %, which was not much different from the adsorptive retention rate (10 %) of the untreated active carbon; thus, they were found to have an excellent adsorbent action.

As explained in the foregoing, according to the present invention, even when the temperature of active carbon is lower than a harmful gas or malodorous gas to be treated and said gas also contains moisture, it becomes possible for the active carbon to treat the gas while preventing the moisture from entering the fine pores of the active carbon and from forming dew condensation; thus, the present invention can provide, without requiring the additional installation of an active-carbon heating device and a gas drying device, as was the case in the prior art, quite inexpensive and simple-to-use water repellent active carbon that has a stable and excellent adsorption performance.